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The Price Impact and Timing of Actual Share Repurchases in Norway

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"When companies with outstanding businesses and comfortable financial positions find their shares selling far below intrinsic value in the marketplace, no alternative action can benefit shareholders as surely as repurchases."

Warren Buffet

Abstract

Little is known about the price impact and timing of actual share repurchases. Data unavailability has hindered research in most countries, including the United States. Using unique data on actual share repurchase transactions from Norway, we test for the price impact and timing of daily open market repurchases. We find evidence that share repurchases typically follow after a negative drift in the stock price, and the average three-day abnormal return around the announcement is 0.54%. Moreover, the initial market reaction is greater for repurchases that are pursued by small firms and for firms that experience a negative drift in the stock price prior to the transaction. The evidence presented is seemingly indicative of managers' intent to signal undervaluation through repurchase transactions. However, we do not find any significant long-term abnormal returns for repurchasing firms. This result suggests that on average, managers do not time the market based on informational advantage.

Keywords: Share repurchases motives, price impact, long-term, timing, signaling, undervaluation, open market repurchases

Note: Throughout this paper, the term "repurchase transaction" is used to refer to the announcement of a repurchase transaction, and the term "repurchase program" is used to refer to the announcement of a repurchase program.

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1 Introduction

The relaxation of repurchase regulations across a host of countries has led to a dramatic rise in global repurchase activity over the past two decades. Share repurchases are now recognized as a global phenomenon and represent a major constituent of corporate payout policy. The growing popularity has sparked great academic interest, which persists to this day. Previous studies find a positive stock price reaction both to announcements of repurchase programs and to repurchase transactions.[1] This price reaction is explained by various hypotheses, including the signaling of undervaluation, agency theory, capital structure, and dividend substitution. Among the numerous studies on motivations for share repurchases, the signaling of undervaluation has been found to be the most popular motive. A survey conducted by Brav, Graham, Harvey, and Michaely (2005) reports that over 80% of managers in the United States engage in repurchase activity when they perceive their stock to be undervalued by the market.

If mangers are signaling undervaluation through share repurchases, it is worthwhile to evaluate if they in fact possess market-timing ability. Former studies report a positive drift in stock prices for several years following repurchase programs, suggesting evidence in favor of managerial timing ability (see e.g., Chan, Ikenberry, & Lee, 2007; Grullon & Michaely, 2004; Peyer & Vermaelen, 2009). However, these studies customarily assume that all repurchase programs are eventually realized, which is not consistent with empirical evidence.[2] The continued research focus on repurchase programs is due to lax repurchase regulations in the United States. Although regulatory amendments since 2004 have made possible monthly record of repurchase trades through quarterly filings, the precise data on daily repurchase transactions are still unavailable in the United States.

[1] Grullon and Michaely (2002), Li and McNally (2007), Vermaelen (1981), and Zhang (2005), among others.

[2] According to Jagannathan et al. (2000) a maximum of 70–80% of announcing firms conduct actual repurchases in United States. Further, according to Skjeltorp (2004), approximately 60% of the announcing firms in Norway repurchased their stock in the period between 1998 and 2001.

Zhang (2005) argues that managerial timing depends on the ability of the management to detect and take advantage of undervaluation errors in executing repurchase transactions. Therefore, examining actual repurchase transactions is a crucial requirement for gaining meaningful insights into managerial timing ability. However, the overall empirical evidence on actual repurchases is relatively limited. Exploiting a unique data set of 7098 daily open-market repurchase transactions from the Oslo Stock Exchange (OSE) initiated between January 2005 and December 2014, we are able to analyze share repurchase transactions on a daily level.

Our first objective is to estimate the price impact of share repurchase transactions and analyze how it may be explained by the various share repurchase motives. The strict disclosure requirements in Norway enable us to improve the understanding of repurchase motives. Our second and perhaps most important objective is to address whether managers possess market-timing ability in executing share repurchase transactions. This would enable us to reconcile academic literature on repurchases to the fact that CFOs list undervaluation as the principal motive behind repurchase decisions.

Our study is particularly relevant in current context, as the Norwegian Government recently suggested raising the personal taxation on dividends. As the regulatory amendment may carry implications for Norwegian firms' payout policy going forward, it is crucial for investors and regulators to fully grasp the intricacies of repurchase transactions when evaluating investment decisions and policy recommendations.

For the Norwegian market, we find only one locally published study on share repurchases: Skjeltorp (2004). Skjeltorp studies the market reaction to repurchase announcements and implementations in the period shortly after share repurchases were allowed in Norway (1999–2001). Although the study is based on a limited data sample, it finds significant positive long-term abnormal returns for firms announcing a repurchase program, but not for repurchasing firms. Our study is a modest contribution to the limited empirical literature on actual share repurchases, and extends the study of Skjeltorp in several ways. First, our study covers a much longer period, from

2005 to 2014, thus significantly extending the data. Second, our study comprises a cross-sectional analysis based on repurchase transactions as opposed to repurchase programs. Finally, the analysis of the long-term performance contributes to the understanding of managerial timing ability in the context of share repurchase transactions.

The remainder of this paper is organized as follows. Section 2 describes the methods and regulatory requirements for share repurchases. Section 3 presents the motives and empirical evidence for share repurchases. Section 4 develops hypotheses related to our research question. Section 5 describes the data and methodology used in the paper. Section 6 presents the main empirical results. Section 7 concludes the paper and adds suggestions for further research.

2 Methods and Institutional Settings

This section highlights the main share repurchase methods and contains a legal review of the Norwegian regulatory environment of open market repurchases (OMR).

2.1 Repurchase methods

Below we briefly describe the three most common types of share repurchase methods: Fixed-price tender offer, Dutch auction and OMR. It is important to note that OMR is the focus of our paper.

Under a tender offer, a firm commits to repurchasing a specific number of shares at a fixed price during a limited period. In case the target number of shares is not met, the firm may decide to terminate the offer. Empirical evidence shows that the repurchase price is usually set at a significant premium of around 13–16% (Grullon & Ikenberry, 2000).

A related method is the Dutch auction tender offer, where the process starts with the management announcing different prices at which it is prepared to repurchase shares. Shareholders choosing to participate indicate how many shares they are willing to sell and the minimum acceptable selling price. At the close of the offer period, the firm pays the lowest price at which it can repurchase its desired number of shares. It is important to note that all tendering shareholders who meet the clearing price are offered the same price regardless of their indicated reservation price. Lie and McConnell (1998) find a small difference between excess announcement returns for tender offers and Dutch auctions.

Finally, in the case of OMR, the firm announces its intention to buy its shares and then proceeds to do so over time as any other investor would. This method provides firms with more flexibility in the timing and size of a repurchase transaction. While tender offers provide the greatest credibility, OMR programs are perceived to be least credible. This perception is consistent with the findings of Comment and Jarrell (1991), who report average excess return of 11% for tender offers, 8% for Dutch auctions, and 3% for

OMR. Nonetheless, OMR programs offer managers greatest flexibility, and according to Allen and Michaely (2003) account for 95% of the dollar value of shares repurchased.

2.2 Norwegian institutional settings

In Norway, regulations enabling share repurchases came into effect in January 1999. Share repurchase activity is regulated by the Securities Act of June 13, 1997 (Aksjeloven) and the Securities Trading Act of June 29, 2007 (Verdipapirhandelloven). Share repurchase programs are subject to safe-harbor exemptions, and are consequently not classified under market manipulation as set out in chapter 3 of the Securities Trading Act. The main purpose of these regulations is to ensure a transparent, secure, and efficient trade of financial instruments that affords equal treatment of all shareholders.

To initiate a share repurchase program, it is required that two thirds of both the votes cast and share capital represented at the shareholder meeting be in favor of the repurchase plan. At the general meeting, the board must disclose all pertinent details related to the share repurchase program including the objective of the program, method of repurchase, maximum number of shares to be repurchased, minimum and maximum amounts to be paid for shares, and the length of the program. After the shareholder authorization is received, the firm must inform the OSE. The repurchasing firm has a maximum of two years to conduct the repurchase before it is required to have a new shareholder vote. However, getting shareholders' approval does not mean that a firm is under any legal obligation to engage in repurchase transactions. Thus, many companies in Norway regularly seek their shareholders' approval, but do not go ahead with repurchase transactions.

The Securities Trading Act allows a firm to buy back shares as long as it does not buy back more than 10% of the outstanding share capital. Furthermore, it is required that the firm's total share capital less total nominal value of treasury shares be always higher than NOK 1 million. Until recently, the act also required firms to finance repurchases through retained earnings.

However, a recent provision in the act enables the use of debt to finance repurchases.

All repurchase transactions conducted by the firm must be publicly disclosed immediately or at the latest prior to opening of the market the following business day. The repurchase notification must include price and volume of the transaction. According to the act, the repurchase price must not exceed the price of the last independent trade or the highest current independent bid at the OSE. In addition, the trade size cannot exceed 25% of the average traded volume of shares over the last calendar month. The shares repurchased by the firm are retained as treasury stock, which has no subscription, voting and cash flow rights. At a later stage the firm can decide to resell the treasury shares in the open market, use it to grant employees, or cancel it at its disposal. The precise use of treasury stock is also agreed upon at the point of repurchase authorization.

3 Literature Review

We divide our literature review into two sections, theoretical and empirical examinations. In the first section, we conduct a review of theories advanced in favor of share repurchases. This is followed by an empirical examination of related literature for our paper.

3.1 Repurchase motivations

Under perfect capital markets, a firm's choice of payout policy has no bearing on its actual value (Miller & Modigliani, 1961). Firm value is essentially a product of its investment policy; thereby its payout policy is irrelevant from the standpoint of value creation. In a frictionless world, a share repurchase has the same effect on cash-flow rights of shareholders as a dividend does. However, as many of the underlying assumptions of perfect capital markets do not hold in the real world, we observe large discrepancies in payout policy across firms.

Management's motivation for share repurchases has been thoroughly discussed in previous literature.[3] It is important to note that at any one point, multiple factors may account for a firm's decision to pursue a share repurchase (Dittmar, 2000). However, for the scope of our paper we mainly focus on the three most widely quoted motives for share repurchases: signaling undervaluation, agency theory and capital structure.

Among the theories coined to explain the management's decision to pursue share repurchases, is the traditional signaling hypothesis. The cornerstone of the signaling hypothesis is the information asymmetry that exists between a firm's insiders and outsiders (Spence, 2002). The management of a firm holds insider knowledge with respect to the firm's competitive position and future prospects, and as a result may disagree with the prevailing market pricing of its equity. Revealing this insider knowledge in an explicit manner could go against the competitive interests of the firm and may also lack

[3] Comment and Jarrell (1991), Dittmar (2000), Grullon and Ikenberry (2000) and Stephens and Weisbach (1998), among others.

credibility. Under this setting, a share repurchase provides a credible medium to signal differences between management's and the market's perception of the true value of the firm (Vermaelen, 1984). The perceived undervaluation by management is therefore considered the primary motive behind share repurchases. This is supported by a survey conducted by Brav et al. (2005). The results of their survey demonstrate that mangers indeed use repurchases to signal undervaluation. As a result, one should expect an appreciation in the firm's stock price following a share repurchase to correct for mispricing.

According to Grullon and Michaely (2004), the perceived credibility of the share repurchase signal stems from the fact that a repurchase demands engaging into a costly action by the firm. However, not all repurchase programs are realized, which cast doubt over the widely claimed signaling credibility of repurchase programs. Interestingly, Ikenberry and Vermaelen (1996) argue that a repurchase program is effectively equivalent to an exchange option whereby the firm acquires the flexibility to exchange its market value for its "fair" value at management's discretion. Regardless of the management view on the current valuation of their stock, the exchange option offers considerable value, and the stock price should rise to recognize this value. However, Zhang (2005) argues that the value of the exchange option relies on the ability of the management to take advantage of valuation errors in making repurchase transactions.

Another widely cited motive for share repurchases is that it provides an effective medium for management to distribute excess cash to shareholders. This distribution of excess cash helps overcome one of the most pertinent issues that arise as a result of separation of ownership and control, namely agency cost of free cash flow (Jensen, 1986). In the presence of excess cash, managers may be tempted to allocate capital into value-depleting projects in an effort to increase the scale of business operations. Through cutting financial slack, there is reduced potential for managers to invest in negative NPV projects. As a result, the market usually greets share repurchases favorably to the extent it views potential for misalignment between managers' and shareholders' interests (Hackethal & Zdantchouk, 2006).

Although the distribution of excess cash can be achieved via both dividends and share repurchases, share repurchases are inherently more flexible, allowing management significant leeway in distributing cash to shareholders. According to Jagannathan, Stephens, and Weisbach (2000), repurchases do not mandate firm commitment. Hence, a firm announcing a share repurchase program may well terminate the program any time at its discretion without provoking any negative market reaction. On the other hand, dividends are a firm commitment and are expected to be offered on a regular basis by the market such that any dividend cut is typically greeted with a negative market reaction (Denis, Denis, & Sarin, 1994). [4]

On a similar note, Jagannathan et al. (2000) conclude that dividends are more likely used by firms with permanent excess cash balance, whereas repurchases are more likely used by firms with temporal excess cash balance. In addition, Grullon and Michaely (2002) argue for the dividend substitution hypothesis based on the tax differentials between dividend income and capital gains. However, given the equivalent tax treatment of dividend income and capital gains in Norway, it is unlikely that tax preference is a repurchase motive for Norwegian firms.

The optimal leverage hypothesis holds that managers may conduct a share repurchase with a goal to fine-tune the firm's capital structure, especially if the repurchase is debt financed. Under the assumption that an optimal leverage ratio exists, the firm may conduct a repurchase to achieve this target ratio, which is expected to generate a positive market reaction (Bagwell & Shoven, 1989).

Other potential motives for repurchases that are not within the scope of our paper include the option dilution hypothesis, takeover deterrence hypothesis, earnings bump hypothesis, and finally the price support hypothesis.

3.2 Related empirical literature

[4] Denis et al. (1994) and Ghosh and Woolridge (1989) find an average stock price drop of about 6% on the three days surrounding the announcement of a dividend cut.

Empirical literature on share repurchases revolves around both its short- and long-term effects. As our paper seeks to address both effects, we find it imperative to review relevant findings in former studies. First, we review the short-term effects of share repurchases and examine the most relevant empirical literature for our paper. Next, we provide empirical evidence pertaining to long-term effects of share repurchases.

Former research on share repurchases can be classified into two strands: studies that analyze the effect of share repurchase programs and studies that analyze the effect of share repurchase transactions. Although the focus of our study is on the latter, we consider it useful to provide a thorough account of both strands of literature to develop a better understanding of the underlying mechanisms driving these effects. Table 3.1 offers a selected list of prominent studies pertaining to both disciplines across various regions.

Table 3.1 Prior empirical results of abnormal returns from share repurchases

Panel A: Abnormal returns from repurchase programs

Country	Author(s)	Sample period	Obs.	Event window	CAR
US	Ikenberry et al. (1995)	1980–1990	1239	(–2, +2)	3.50%***
	Stephens and Weisbach (1998)	1981–1990	591	(–1, +2)	2.70%***
	Grullon and Michaely (2002)	1980–1997	4443	(–1, +1)	2.57%***
	Chan, Ikenberry, and Lee (2004)	1980–1996	5508	(–2, +2)	2.18%***
	Lie (2005)	1981–2000	4729	(–1, +1)	3.00%***
	Peyer and Vermaelen (2005)	1984–2001	6470	(–1, +1)	2.39%***
	Lee, Park, and Pearson (2015)	2007–2011	2395	(–2, +2)	1.37%***
UK	Rau and Vermaelen (2002)	1985–1998	126	(–2, +2)	1.08%***
Canada	Li and McNally (2007)	1987–2000	1702	(–1, +2)	0.73%***
Germany	Andriosopoulos and Lasfer (2013)	1997–2006	194	(–1, +1)	2.32%***
France	Ginglinger and L'her (2006)	1998–1999	363	(0, +1)	0.57%***
Australia	Lamba and Ramsay (2000)	1989–1998	103	(–1, +1)	2.81%***
Japan	Zhang (2002)	1995–1999	126	(–1, +2)	4.58%***

Panel B: Abnormal returns from repurchase transactions

Country	Author(s)	Sample period	Obs.	Event window	CAR
UK	Rees (1996)	1981–1990	882	(–2, +2)	0.30%***
Hong Kong	Zhang (2005)	1993–1997	800	(0, +2)	0.43%***
Australia	Akyol and Foo (2013)	1998–2008	927	(0, +1)	0.43%***
Norway	Skjeltorp (2004)	1999–2000	100	(–1, +1)	0.88%***

An examination of the extant literature reveals some interesting patterns. First, a vast majority of studies in the United States, where share repurchases are most prevalent, are focused on repurchase programs as opposed to studies in other regions that are geared towards repurchase transactions.[5] This discrepancy in the literature is in accordance with the observed regulatory differences. The US Securities and Exchange Commission (SEC) rules do not enforce repurchasing firms to report actual repurchase activity, in addition to the basic, standard disclosure in the quarterly financial statements. This is in sharp contrast to most other regions including Norway; where there are stringent regulations mandating repurchasing firms to separately disclose repurchase activity on a daily account.

Second, while abnormal returns are positive across all studies, they are slightly higher in the United States than in other regions, particularly Europe. This could again be attributed to regulatory differences between the United States and other regions. While a decision to announce a share repurchase program is subject to board approval in the United States, the same decision in most other countries, including Norway, needs to be authorized by shareholders at the shareholder meeting. Manconi, Peyer, and Vermaelen (2013) argue that in "shareholder approval" countries, repurchase authorizations are routinely requested at annual general meetings, therefore share repurchase announcements in these countries are often expected, which explains their relatively lower abnormal returns.

Third, there appears to be a decline in abnormal returns relating to share repurchases in the recent past, at least in the United States. Lee, Park, and Pearson, (2015) find that recent announcements of share repurchase programs are arguably more driven by pressure from short-term-oriented institutional investors and changes in executive compensation policy.

Finally, we observe that the average abnormal returns on share repurchase programs are larger in magnitude in comparison to average abnormal returns

[5] According to Manconi et al. (2013), since 1998, approximately 10% of all US listed firms announced a share repurchase program.

on share repurchase transactions. This stem from the fact that a price adjustment is already incurred at the point of repurchase program; hence, a subsequent adjustment at the point of repurchase transaction is relatively smaller in scale.[6]

Regarding the earlier-stated motives of share repurchases, there is overwhelming empirical support for the signaling undervaluation hypothesis, whereby firms use share repurchases to signal mispricing of their stock. Notable studies in this regard include Comment and Jarrell (1991), Dann (1981), Ikenberry et al. (1995), and Vermaelen (1981), among others. These are complemented by CFO surveys including those of Brav et al. (2005) and Mitchell, Dharmawan, and Clarke (2001). With respect to the agency cost of free cash flow hypothesis, Jagannathan et al. (2000) and Stephens and Weisbach (1998) argue that firms with excess cash flows enjoy higher abnormal returns after the announcement of a repurchase program.

Concerning the long-term effects of share repurchase programs, Ikenberry et al. (1995) find significant abnormal returns. They assert that the long-term abnormal returns of share repurchase programs are driven by initial market under-reaction. Their findings are confirmed by a host of subsequent international studies including Chan, Ikenberry, and Lee (2007) and Zhang (2002), among others. However, Yook (2010) argues that long-term abnormal performance originates from program announcing firms that subsequently execute repurchase transactions. This is consistent with the evidence presented by Lie (2005) who finds significant improvements in long-term operating performance of program announcing firms that execute repurchase transactions.

However, these findings contrast with that of Skjeltorp (2004), who argues that the presence of long-term abnormal returns in Norway is due to the portion of firms that do not subsequently execute share repurchase transactions. He finds that program announcing firms that do not subsequently repurchase are on average more cash constrained. Therefore these firms are

[6] Zhang (2005) argues that the difference in abnormal returns is expected because a repurchase program announcement represents a major corporate decision; however, a repurchase transaction represents a mere implementation of the repurchase program.

not able to signal mispricing through repurchase transactions, and continue to remain undervalued. At a later stage, positive information surprises through earning announcements drive the abnormal performance of these firms. Another interesting study by Jagannathan and Stephens (2003) finds that there are differences in motives of frequent and infrequent repurchasers, and as confirmed by Yook (2010), long-term abnormal returns are indeed attributed to infrequent repurchasers.

On the other hand, Bradford (2008) and Mitchell and Stafford (2000) find no evidence of abnormal returns experienced by announcing firms. Fama (1998) argues that studies of long-term abnormal returns are susceptible to sampling bias in addition to choice of expected return model; this is probably why we observe variation in the results of the quoted studies. Another interesting issue when estimating long-term performance is the inclusion of transaction costs. McNally and Smith (2007) show that anomalies related to long-term behavior of announcing firms vanish once transaction costs are accounted for.

The presented controversial empirical evidence on long-term abnormal performance has resulted in a discourse about the managerial timing ability of stock repurchases.

4 Hypothesis Development

As earlier stated, the purpose of this paper is twofold. First, we attempt to investigate repurchase motives by evaluating cross-sectional differences in the initial price impact. Second, we investigate whether managers are able to time the market when executing share repurchase transactions. The extant literature review provides us with a basis to develop the following framework for testable hypotheses.

4.1 Hypotheses related to the price impact

The price impact of share repurchases is widely examined across countries. Table 3.1 in Section 3.2 provides consistent evidence of significant positive abnormal returns for share repurchase transactions on the event day. In accordance with the previous studies, we develop the following hypotheses:

H0. *There is no positive price impact of share repurchase transactions on the event day.*

H1. *There is a positive price impact of share repurchase transactions on the event day.*

In case the null hypothesis is rejected, we aim to further understand which repurchase motives can explain the positive price reaction on the event day. To achieve this purpose, we formulate the following set of auxiliary hypotheses:

H1.1. *The signaling undervaluation hypothesis explains the positive price impact.*

As discussed in Section 3.1, the most commonly quoted reason for share repurchases is the managers' perception that their stock is undervalued. Following Chan et al. (2004), we use firm size, intangibles-to-assets ratio, repurchase size, market-to-book ratio, and cumulative abnormal returns (CARs) preceding repurchase transactions to proxy for the signaling undervaluation hypothesis.

According to Vermaelen (1981), smaller firms are exposed to more information asymmetry and are therefore more likely to be mispriced as opposed to larger firms, which typically have wider media and analyst coverage. Hence, we expect that the price impact is negatively related to firm size. Similarly, Barth and Kasznik (1999) argue that there is greater uncertainty about the value of a firm with a higher ratio of intangibles-to-assets and therefore such a firm experiences a higher degree of information asymmetry. Further, we include the size of the repurchase transaction to capture the credibility of the undervaluation signal. Although this variable could be related to all three auxiliary hypotheses, Chan et al. (2004) argue that the size of the repurchase transaction is most consistent with the signaling undervaluation hypothesis. Thus, we expect the repurchase size to be positively related to the market reaction. Another key metric that captures the extent of undervaluation and investment opportunities is the firm's market-to-book ratio. Dittmar (2000) suggests that high market-to-book firms (growth firms) are less likely to be perceived as being undervalued by the market as opposed to low market-to-book firms (value firms). Therefore, we should expect a higher positive market reaction to repurchase transactions carried out by value firms. Finally, Zhang (2005) finds that share repurchase transactions that are preceded by a negative drift in the stock price, generate a stronger undervaluation signal. Therefore, we expect prior share price performance to be negatively related to the price impact of repurchase transactions.

H1.2. *The agency cost of free cash flow hypothesis explains the positive price impact.*

As argued by Jensen (1986), firms with an excess cash balance are faced with agency conflicts surging from self-interested managers who use excess funds to their benefit. These agency conflicts impose a penalty on firms, and by disgorging cash through a share repurchase, managers can tax-efficiently recover this penalty (Chan et al., 2004). Following Fenn and Liang (2001) we use earnings before interest, taxes and depreciation (EBITDA) less cap-

ital expenditures scaled by assets as our proxy for free cash flow. This coefficient is expected to be positive, as distribution of cash to shareholder will mitigate possible agency conflicts. In a similar fashion, Hatakeda and Isagawa (2004) argue that the market is likely to react more positively to repurchases by firms with lower return on assets as opposed to repurchases conducted by firms with higher return on assets. This argument implies that the market rewards only repurchases made by firms that have unattractive investment opportunities. Return on assets is therefore included as another explanatory variable in our regression equation, and the coefficient is expected to be negative.

H1.3. *The optimal capital structure hypothesis explains the positive price impact.*

Under the optimal leverage hypothesis, a firm may use share repurchases to optimize its capital structure (Bagwell & Shoven, 1989). An optimal level of leverage not only should lead to an interest tax subsidy, but also should reduce agency costs. Following Dittmar (2000) and Grullon and Michaely (2004), we use total debt scaled to assets for testing the hypothesis related to optimum financial leverage. We expect abnormal returns to be positively related to leverage.

The null for each of the auxiliary hypotheses is that they do not explain the positive price impact from share repurchases. We summarize the auxiliary hypotheses in the following table:

Table 4.1 Summary of hypotheses and predictions

Variables	Predicted sign	Hypothesis
Firm Size	Negative	Signaling Undervaluation
Intangibles-to-assets	Positive	
Prior drift in share price	Negative	
Market-to-book	Negative	
Repurchase size	Positive	
Cash	Positive	Agency cost of free cash flow
Return on assets	Negative	
Leverage	Positive	Optimal capital structure

4.2 Hypotheses related to managerial timing ability

The market timing hypothesis states that managers can buy back shares at lower prices through their informational advantage about the "true" value of the stock (De Cesari, Espenlaub, Khurshed, & Simkovic, 2012). Therefore, if managers are able to time the market, they can transfer wealth from tendering to non-tendering shareholders (Fried, 2005a). Although the Security Trading Act in Norway prohibits managers from conducting buybacks based on inside information, we are not aware of any case where a repurchase has led to regulatory sanctions for insider trading. In fact, repurchase trades that meet the requirements of the commission regulation are subject to safe harbors. Evidence pertaining to managerial timing of share repurchase transactions is supported by Chan et al. (2007) and Yook (2010), who find significant positive long-term abnormal performance for repurchasing firms. This leads to our final hypotheses:

H0. Repurchasing firms do not experience long-term abnormal returns.

H2. Repurchasing firms experience long-term abnormal returns.

5 Data and Methodology

5.1 Data description

In this section, we provide a descriptive summary of the entire share repurchase activity conducted on the OSE from the start of 2005 until the end of 2014. The share repurchase data are collected from the OSE, and daily share price data are collected from Amadeus (Børs Prosjektet), a data service operated at the Norwegian School of Economics (NHH). Table 5.1 provides a summary of all share repurchase transactions executed by all repurchasing firms across our sample period.

Table 5.1 Summary descriptive of all repurchases in Norway 2005–2014

Number of firms	189
Number of repurchase events	7098
Total number of shares repurchased (in millions)	1223.7
Aggregate value of shares repurchased (in billion NOK)	60.8
Number of firms with 1 repurchase event	28
Number of firms with 2–10 repurchase events	65
Number of firms with 11–20 repurchase events	36
Number of firms with 21–40 repurchase events	17
Number of firms with over 40 repurchase events	43

From 2005 to 2014, 189 firms conducted in total 7098 repurchase transactions valued at NOK 60.8 billion.

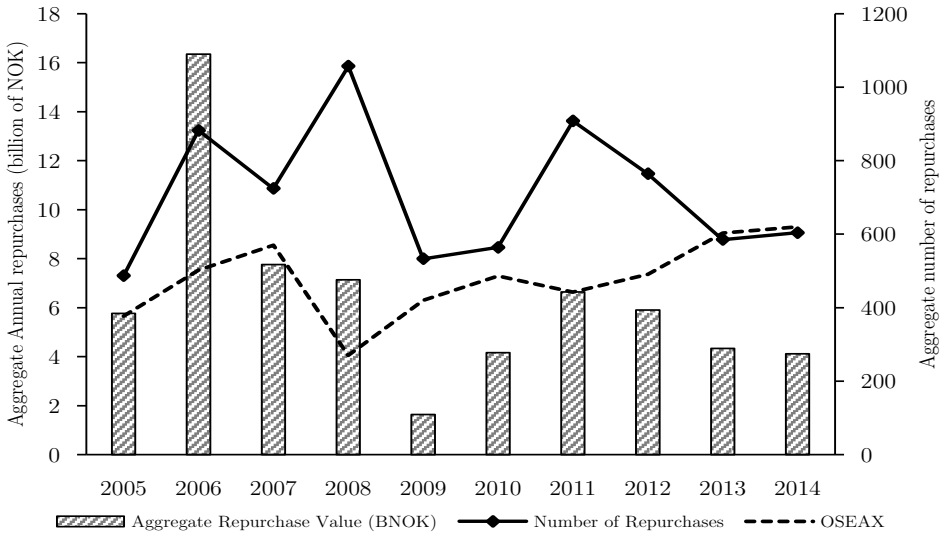

Figure 5.1 Aggregate repurchases (left scale) vs. number of repurchases (right scale)

From Figure 5.1 we note that both the number of repurchasing firms and share repurchase events peaked during the height of the financial crisis in the year 2008. This indicates Norwegians firms' tendency to repurchase more during recessionary periods. On the contrary, Dittmar and Dittmar (2008) show that in the United States, repurchase activity rises during boom periods and falls during recessionary periods. However, as evident from Figure 5.1, the aggregate value of share repurchases in 2008 is lower than that of some of the other years in our sample, and we expect this to be the result of the depressed equity market.

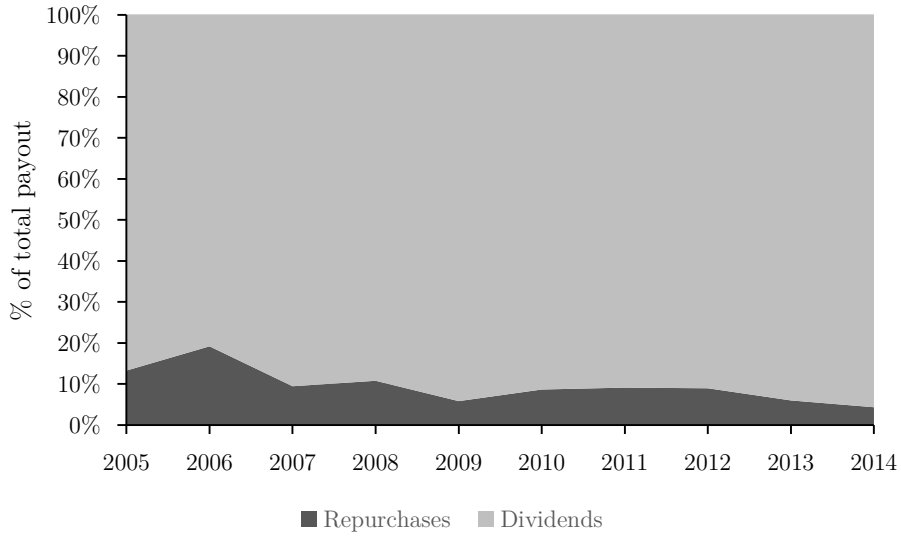

Figure 5.2 Repurchases vs. dividends as % of total payout on the Oslo Stock Exchange

Since share repurchases were allowed in the United States, firms have increasingly substituted dividends with share repurchases, which is now the dominant mean of payout (Skinner, 2008).[7] Rixtel and Villegas (2015) report that share repurchases totaled approximately USD 950 billion in 2013–2014. From Figure 5.2 we clearly see that share repurchases have not gained the same popularity in Norway as in the United States, representing a low share of the total capital distributed to investors.

Table 5.2 provides descriptive statistics for the size of repurchase activity across sample period. First, we observe that the number of repurchase transactions that involve buying back 1% or more of the total shares outstanding

[7] In 2004, repurchases for US industrials were USD 155 billion while dividends were USD 137 billion.

have generally decreased in the post financial crisis period. Second, throughout our sample period, we observe that roughly 90% of repurchase events involved buying back less than 0.5% of the total shares outstanding. This may be the result of low market liquidity, making it difficult to process large block transactions.

Table 5.2 Yearly distribution of share repurchases by the % of daily purchase transactions

Size of repurchase	Number of repurchase events by year										
(%)*	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
≥1%	21	19	13	20	9	8	9	6	10	6	121
0.90–0.99	4	3	2	5	0	1	1	1	0	0	17
0.80–0.89	1	3	2	0	0	0	0	0	0	1	7
0.70–0.79	2	11	4	0	2	0	2	0	1	0	22
0.60–0.69	1	4	3	5	4	1	2	1	1	0	22
0.50–0.59	5	11	9	9	3	1	3	0	1	1	43
<0.50	449	829	691	1017	515	552	890	756	572	595	6866
Total	483	880	724	1056	533	563	907	764	585	603	7098

Further examination of our data in Table 5.3 reveals that out of the total sample of 189 firms, 22 firms bought back more than 10% of their shares outstanding over our sample period. Note that this exceeds the 10% regulatory threshold, but this is probably achieved through multiple repurchase programs or through cancellation of treasury shares. Moreover, 103 firms bought back between 1% and 10% of total shares outstanding and 45 firms bought back less than 0.5% of their total shares outstanding across the same period. This implies that although firms generally repurchase a minuscule fraction of total shares outstanding in any one share repurchase transaction, on the whole, most firms buy back more than 1% of their shares outstanding through multiple transactions. This is clear as approximately 85% of firms in our sample register more than one repurchase transaction.

Table 5.3 Size of repurchase by all repurchasing firms

Size of repurchase (%)*	Number of firms
Above 10%	22
1.00–10.00	103
0.76–0.99	8
0.50–0.75	12
Below 0.50	45
Total	189

* Cumulative repurchases across sample period

Since the focus of this study is on the OMR of the ordinary shares traded at the OSE, we exclude equity certificates from our event sample. As some firms may engage in repurchase activity over consecutive days, it could lead to clustering of events. To control for clustering bias, we employ a 21-day filter between each repurchase transaction. If we considered each repurchase transaction, then firms with a higher repurchase frequency, such as Telenor, would dominate the sample portfolio returns.[8] Conversely, if we only focused on the first repurchase transaction for each firm then we ignore much useful information in the subsequent repurchases. The 21-day restriction further ensures that repurchase transactions are not overlapping in the event window. Further, to isolate the effect of repurchase trades and their publication, we exclude those events that have announced price–affecting information on the same day or the trading day prior to the announcement day.[9] This leaves us with a final sample for the analysis of 819 repurchase events conducted by 154 firms.[10] Other information, such as daily index prices and Fama–French factors, is obtained from Bent Ødegaard's website at BI's asset- pricing center. In addition, accounting data are retrieved from Thomson Reuters Datastream.

[8] In the sample period, Telenor conducted a total of 305 repurchase transactions against an average of 37 repurchase transactions per firm.

[9] Using a matlab code, we extract press-release information from the OSE database (Newsweb) surrounding the three-day event window for all repurchase transactions.

[10] A total of 347 announcements are excluded because of reported price-affecting information, 5304 announcements are excluded after employing the 21-day filter, 114 announcements are excluded because they have a return history too short for estimating the market-model parameters and 514 announcements are excluded due to lack of share price and accounting data.

5.2 Methodology

This section presents and evaluates the methodologies employed to test the stated hypotheses in Section 4. Our analysis is conducted in three stages. First, we present a standard event study methodology for examining the price impact of share repurchase transactions. Second, we describe the regression equation applied to test the repurchase motives that explain the price impact. Finally, we evaluate the choice of long-term performance estimation methods to test for the managerial timing ability.

Univariate analysis

For the univariate analysis, we use standard event study methodology, as proposed by MacKinlay (1997), to measure the sample securities' mean and cumulative mean abnormal returns, surrounding share repurchases. To estimate abnormal returns, we use the market model. It is widely accepted that the use of more sophisticated models has little effect on abnormal returns when examining the short-term market impact.[11]

To estimate the model parameters, a standard ordinary least squares (OLS) regression is applied for each stock i over a 250-day period prior to the event window, using the OSEAX All Share Index as the proxy for the market return. The announcement window is defined as the day of the public announcement of a repurchase transaction, according to the OSE database. To capture price movements surrounding share repurchases, we find it suitable to use an event window of 21 days, from day –10 to day +10 relative to the event day. Figure 5.3 illustrates the timing sequence of the event study.

[11] See Brown and Warner (1985) and Campbell, Lo and MacKinlay (1997).

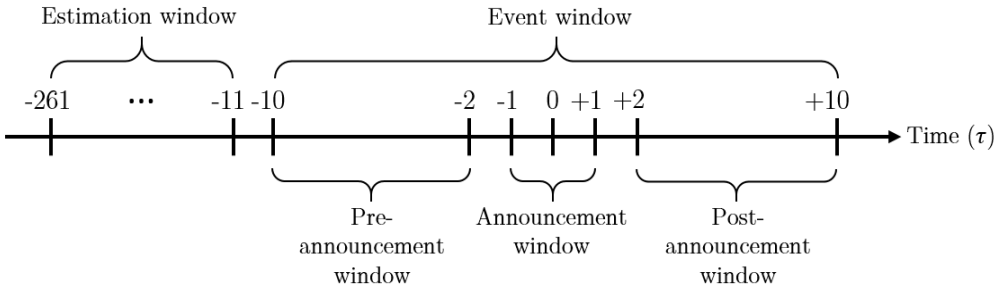

Figure 5.3 Timing of the event study

Applying the market model, the expected daily return is calculated as,

$$E(R_{i,t}) = \hat{\alpha}_i + \hat{\beta}_i R_{m,t} \tag{5.1}$$

where $R_{i,t}$ is the expected return for stock i at day t, $R_{m,t}$ is the return on the market index for day t, $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the market-model parameters.

Because several companies at the OSE, and hence in our sample, are not traded daily, our OLS β may be biased due to nonsynchronous trading, see Brown and Warner (1985). To reduce the potential bias, β is adjusted using the Scholes and Williams (1977) procedure, calculated as,

$$\beta_{SW} = \frac{\hat{\beta}_i^- + \hat{\beta}_i + \hat{\beta}_i^+}{1 + 2\hat{\rho}_M} \tag{5.2}$$

where $\hat{\rho}_M$ is the first-order autocorrelation coefficient of the return on the market and $\hat{\beta}_i^-$, $\hat{\beta}_i$, $\hat{\beta}_i^+$ are the lagged, matching, and leading beta estimates, respectively.

The abnormal return is calculated as the difference between actual return and the expected return in the event window,

$$AR_{i,t} = R_{i,t} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t}) \tag{5.3}$$

where $AR_{i,t}$ is the abnormal return of firm i at day t in the event period, R_{it} is the actual share return on firm i at day t in the event period, $R_{m,t}$ is the return on the market index at time t in the event period, $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the market model parameters.

By cumulating the abnormal returns from the event window, we can calculate the estimated average CAR across all firms as,

$$CAR(\tau_1, \tau_2) = \frac{1}{N} \sum_{i=1}^{N} \sum_{i=-10}^{+10} AR_{i,t} \tag{5.4}$$

where N is the total number of firms/events.

The null hypothesis to be tested is that the CAR during the event widow is equal to zero. To determine the statistical significance of the abnormal returns and the CARs, we use the standard test statistic proposed in Brown and Warner (1985).

Cross-sectional analysis

We conduct a multiple regression analysis to examine which repurchase motives explain the price impact in the announcement window. For our dependent variable, we focus on CARs over one trading day before the event up until one trading day after the event, CAR (–1, +1). As firms can report to the OSE before the trading starts on the following day, day –1 captures the effect of market participants detecting the presence of the firm through abnormal trading volume or increased demand for the shares, putting an upward pressure on the price. The auxiliary hypotheses discussed in Section 4 lead us to the following regression equation,

$$\begin{aligned} CAR_i(\tau_{1,}\tau_2) = \; & \alpha + \; \beta_1 SIZE_{i,\tau_1-1} + \beta_2 PRECAR_{i,\tau_1-k} \\ & + \beta_3 REPSIZE_{i,\tau_1} + \beta_4 ROA_{i,\tau} \\ & + \beta_5 MTBV_{i,\tau_1-1} + \beta_6 INTANG_{i,\tau} + \beta_7 CASH_{i,\tau} \\ & + \beta_8 LEVERAGE_{i,\tau} + \varepsilon_{i,t} \end{aligned} \tag{5.5}$$

where α is the intercept term, $CAR_i(\tau_{1,}\tau_2)$ is the CAR of firm i over trading day –1 up to trading day +1 relative to the repurchase day, τ are the variables respective values at the last reported date before the event. See Table A.2 in the Appendix A for a description of the variables.

Measuring long-term abnormal performance

As documented in several former studies of corporate events, long-term performance analysis presents a classical test of managerial timing ability. As opposed to short-term performance measurement, long-term performance measurement is confronted with severe challenges entailing accurate risk adjustments. While the errors in risk adjustments in estimating abnormal performance over a short horizon may have trivial effects, these errors can have economically significant effects for estimating abnormal performance over a long horizon. Further, the use of historical risk estimates becomes irrelevant for long-term event studies as events are typically followed by periods of unusual price performance. Therefore, it is a standard practice to estimate abnormal performance over a long horizon based on post-event estimates. However, this estimation requires the use of an expected-return model, and as Fama (1998, p. 291) notes: "all models for expected returns are incomplete descriptions of the systematic patterns in average returns." In this regard, long-term event studies are essentially joint tests of market efficiency as well as the model of expected returns.

The two most widely used methods for measuring and calibrating post-event risk-adjusted performance are the buy-and-hold average returns (BHAR) and Jensen's alpha (also known as calendar-time portfolio). The rapid growth of academic literature over the past two decades has overcome many of the statistical biases associated with these approaches, but as Kothari and Warner (2007, p. 28) note: "Despite an extensive literature, there is still no clear winner in a horse race." Therefore, we choose to implement both of these approaches to enhance the credibility of our findings.

Buy-and-Hold Average Return (BHAR)

The BHAR approach is widely renowned for its ability to precisely reflect investors' actual investment experiences as opposed to the periodic rebalancing required in the application of the calendar-time approach (Barber & Lyon, 1997). Mitchell and Stafford (2000, p. 296) describe BHAR as "the

average multiyear return from a strategy of investing in all firms that complete an event and selling at the end of a pre-specified holding period versus a comparable strategy using otherwise similar nonevent firms". The nonevent firms are typically matched against event firms based on their respective size and book-to-market values. However, given the relatively limited choice of firms listed on the OSE, it is difficult to conduct a matching procedure in an optimal manner. Additionally, as argued by Kothari and Warner (1997), it is not necessarily enough to match firms based on size and book-to-market, but also on other firm characteristics. Therefore, we choose to match returns of a repurchasing firm against its relevant industry benchmark index. The use of market indices as a benchmark is in line with McNally and Smith (2007). Following Ikenberry et al. (1995), an equal weighting scheme is applied to the portfolio of repurchasing firms. The portfolio is rebalanced at the end of each year to ensure that a small set of firms with extreme compounded returns does not dominate the return calculation in the next period. Accordingly, BHAR reflects the difference between the compounded daily returns of the repurchasing firm and the compounded daily return of the relevant Global Industry Classification Standard (GICS) value-weighted benchmark index. This is shown by the equation below:

$$BHAR_i = \prod_{t=1}^{T}(1 + R_{i,t}) - \prod_{t=1}^{T}(1 + R_{b,t}) \tag{5.6}$$

where $R_{i,t}$ is the compounded return of security i from $t = 1$ to $t = T$, and $R_{b,t}$ is the compounded return of the relevant benchmark index from $t = 1$ to $t = T$. $BHAR_i$ provides an estimate of the compounded abnormal return of security i over the holding period T.

We estimate BHAR for various holding periods including 1, 2, and 3 years after the repurchase incident. The average BHAR for each respective holding period is computed as the equally weighted average of each individual BHAR:

$$\overline{BHAR} = \sum_{t=1}^{N} w_i BHAR_i \tag{5.7}$$

However, the BHAR approach is prone to a number of statistical issues, which cast doubt over its validity. The criticism put forward by Kothari and Warner (2007) is that long-term returns tend to be rightly skewed which departs from the normality assumption underlying many statistical tests. Mitchell and Stafford (2000) argue that this skewness is partially a by-product of cross-sectional dependence of event firms' abnormal returns that are overlapping in calendar time. As a result, t-statistics can be overstated up to four times the normal size. Another issue related to BHAR is that it is extremely vulnerable to the bad-model problem due to the compounding effect of systematic errors (Fama, 1998).

Calendar-time portfolio

This approach requires constructing calendar-time portfolio returns of firms that complete an event, and calibrating whether they are abnormal in a single-factor (CAPM) or multifactor (Fama–French three-factor and Carhart four-factor) regression. Any abnormal performance is captured by the estimated intercept of the regression, alpha. Our application of Jensen's alpha methodology involves constructing a calendar-time portfolio of repurchasing firms. The portfolio is rebalanced on a monthly basis whereby each stock is allocated an equal weight. The rebalancing activity is likely to carry some transaction costs; however, we do not expect these costs to have a material effect on our results due to monthly rebalancing. Similar assumptions are made by Chan et al. (2007) and Yook (2010) in their analyses. Any firm that executes a repurchase in any given month is included in the portfolio the first day of the following month, and stays in the portfolio until it

is subjected to any significant corporate event, such as acquisitions or delisting. We test for abnormal performance across different portfolio holding periods of 1, 2, and 3 years. Each repurchasing firm is part of the portfolio for the duration of the corresponding holding period after which it is removed, and added back only if it executes another repurchase transaction. This framework ensures that at any one given point, the portfolio contains only those firms that are both alive and have initiated repurchases that correspond to the chosen holding period.

As noted earlier, abnormal return estimation under calendar-time portfolio approach involves measuring daily portfolio returns relative to a benchmark model. We choose the Fama and French (1993) three-factor model and the Carhart (1997) four-factor model as our benchmarks. Similar to BHAR, market returns are based on a value-weighted index. This is in accordance with the fact that our sample is fairly dominated by large firms. We first estimate daily portfolio returns and regress excess portfolio returns on the relevant risk factors based on the following equations,

$$R_{p,t} = \sum_{i=1}^{n} W_i R_{i,t} \tag{5.8}$$

$$\begin{aligned} R_{p,t} - R_{f,t} = \alpha_p & \\ & + \beta_m (R_{m,t} - R_{f,t}) \\ & + \beta_{smb} R_{smb,t} + \beta_{hml} R_{hml,t} + B_{mom} R_{mom,t} + \varepsilon_i \end{aligned} \tag{5.9}$$

where $R_{p,t}$ is the equally weighted portfolio return of repurchasing firms for calendar month t, $R_{i,t}$ is the return of firm i for calendar month t, w_i is the respective weight associated to each firm in the calendar-time monthly portfolio, $R_{f,t}$ is our proxy for the risk-free rate, $R_{m,t}$, $R_{smb,t}$, $R_{hml,t}$, $R_{mom,t}$, are the returns on the market benchmark, size, book-to-market and momentum portfolios respectively, and the $\beta' s$ are the portfolios' exposures. α_p measures the average monthly abnormal return on the portfolio of repurchasing firms relative to excess return on the factor portfolios. Under the null hypothesis, α_p is expected to be zero.

The main merit of this approach is that it is immune to biases originating from cross-correlations between event firms. By forming monthly calendar-time portfolios, all cross-correlations of event firms' abnormal returns are automatically reflected in the portfolio variance. Hence, the distribution of abnormal returns is better approximated by the normal distribution, allowing for classical statistical inferences. Further, unlike event-time methods, calendar-time approach controls for clustering of events and is not particularly exposed to pseudo market timing.[12] This is especially important in our case as the vast majority of repurchases are executed in depressed equity markets.

However, the calendar-time approach may suffer from heteroskedasticity due to the changing composition of the portfolio, as the number of repurchasing firms varies each month (Lyon, Barber, & Tsai, 1999).

[12] Schultz (2003) defines pseudo market timing as that which occurs when managers time corporate events based on prior stock performance and ex-post empirical analysis detects abnormal returns, even when there is no mispricing ex-ante.

6 Empirical Results

We examine the price impact of repurchase transactions in Section 6.1, the relationship between the price impact and repurchase motives in Section 6.2, and the long-term performance of repurchasing firms in Section 6.3.

6.1 Short-term price impact of repurchase transactions

This section presents the short-term price impact around share repurchase transactions. In Table 6.1, we present the abnormal share price performance surrounding the repurchase event day for the full sample. Panel A illustrates daily abnormal returns and daily CARs, while Panel B illustrates CARs over five sub-windows. The window (–10, –2) is used to examine pre-event drift in abnormal returns. The window (–1, +1) and (0, +1) are used to capture the initial market reaction to repurchase transactions. Finally, CAR (+2, +10) is used to examine the short-term market response following the event day.

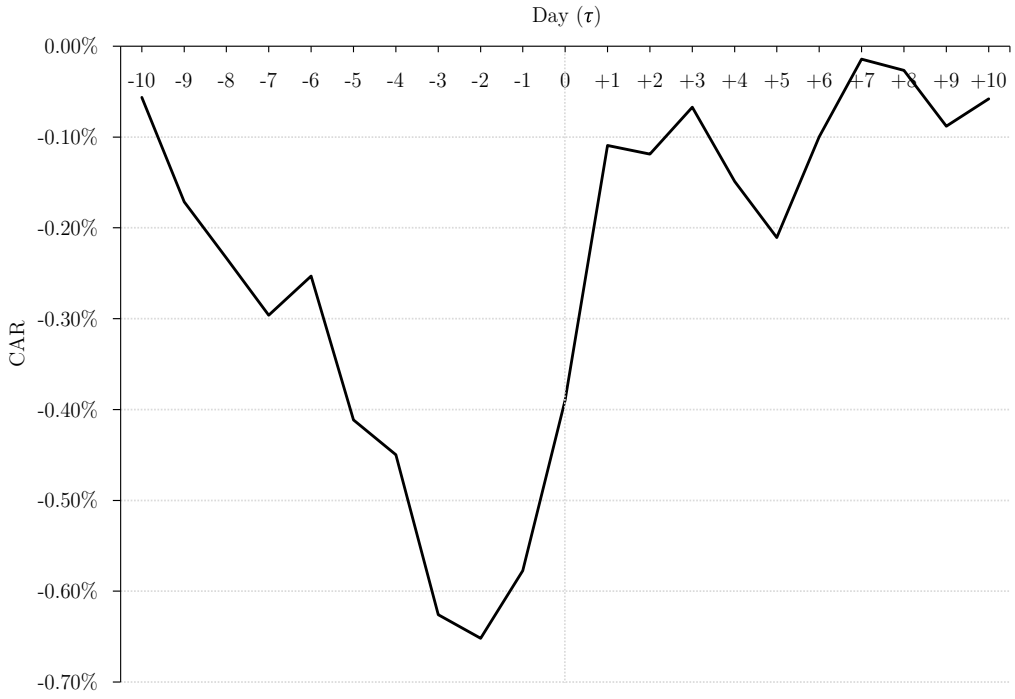

Figure 6.1 Event window CARs
This figure presents CARs from day –10 to day +10 around share repurchase transactions

Table 6.1 Abnormal returns and CARs around repurchase transactions
We use standard event study methodology based on the market model. The market Index is the OSEAX All Share Index. The estimation period is from 261 to 11 days prior to the announcement and day 0 is the announcement date. The sample consists of 819 share repurchase trades for the period January 2005 to December 2014. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Daily ARs and CARs relative to actual share repurchase day

Day	AR (%)	t-stat	CAR (%)
–10	–0.056	–0.80	–0.056
–9	–0.115	–1.40	–0.172
–8	–0.061	–0.75	–0.233
–7	–0.063	–0.76	–0.296
–6	0.043	0.52	–0.253
–5	–0.158*	–1.92	–0.411
–4	–0.039	–0.47	–0.450
–3	–0.176**	–2.14	–0.626
–2	–0.026	–0.31	–0.652
–1	0.074	0.90	–0.577
0	0.188**	2.28	–0.390
+1	0.280***	3.40	–0.109
+2	–0.009	–0.11	–0.119
+3	0.052	0.63	–0.067
+4	–0.082	–0.99	–0.149
+5	–0.062	–0.75	–0.211
+6	0.111	1.34	–0.100
+7	0.086	1.04	–0.014
+8	–0.013	–0.15	–0.027
+9	–0.062	–0.75	–0.088
+10	0.030	0.37	–0.058

Panel B: CARs over different intervals

Event window	CAR (%)	t-stat
Day –10 to –2	–0.652***	–2.63
Day –1 to +1	0.542***	3.80
Day 0 to +1	0.468***	4.01
Day +2 to +10	0.051	0.21
Day –10 to +10	–0.058	–0.15

The mean CAR (–10, –2) value for all repurchasing firms is –0.65%, and it is significantly different from zero. From Figure 6.1 we observe a price decline in share price before a repurchase transaction, which may indicate that managers on average time repurchases after a negative drift in the stock price. The result is consistent with Ikenberry et al. (2000) who argue that managers repurchase more in periods when the stock price declines, as they may perceive the firm to be undervalued. The initial market reaction to the announcement is significantly positive with a CAR of 0.54% in the (–1, +1) window and 0.47% for the (0, +1) window. This suggests that on average, repurchase transactions have a positive impact on stock prices. Although the positive response is statistically significant from zero, the economic magnitude is relatively small. After the event, the CAR for the (+2, +10) window is insignificant. This is consistent with the efficient market hypothesis which states that information should be impounded into the stock price around the event (Ikenberry et al., 2000).

Table 6.2 Industry effects on CARs
The table presents CARs in the pre-event and event windows by industry category. We use standard event-study methodology based on the market model. The market index is the OSEAX All Share Index. The estimation period is from 261 to 11 days prior to the announcement, and day 0 is the announcement date. The sample consists of 819 share repurchase trades for the period January 2005 to December 2014. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

	CAR (–10, –2)		CAR (–1, +1)		CAR (0, +1)	
	CAR(%)	t-stat.	CAR(%)	t–stat.	CAR(%)	t–stat.
Oil & Gas	–0.003	–0.82	0.003	1.26	0.002	1.30
Basic Materials	0.007	0.39	0.002	0.17	0.002	0.26
Industrials	–1.210**	–2.42	0.800***	2.76	0.540**	2.27
Consumer Discretionary	–0.015	–0.94	–1.760*	–1.91	–0.004	–0.47
Consumer Staples	–0.009	–0.81	–0.002	–0.33	–0.001	–0.16
Health Care	0.011	0.86	1.670**	2.28	1.720***	2.89
Financials	–0.002	–0.30	0.002	0.44	0.000	0.10
Information Technology	–1.900**	–2.57	0.990**	2.31	0.950***	2.72
Telecommunication	0.018	1.57	0.009	1.35	0.005	0.87

Table 6.2 illustrates the pre-event and event CARs for nine industry categories. On average, the price decline prior to a repurchase transaction is highest for information technology and industrial firms. Further, the initial market reaction is most pronounced for health care firms.

In sum, the average initial market response to repurchase transactions is significantly positive, which leads us to reject the null and conclude that repurchase transactions have a positive impact on share prices. Our results are consistent with the findings in several studies including Akyol and Foo (2013), Skjeltorp (2004) and Zhang (2005). However, the price impact of repurchase transactions is not substantial, which is in line with our earlier discussion in the literature review. As it is mandatory that Norwegian firms obtain shareholders' approval prior to embarking on repurchase programs, firms' repurchase transactions are partly anticipated.

6.2 Relationship between CARs and firm characteristics

In this section, we perform a cross-sectional analysis consistent with our auxiliary hypotheses. Following Akyol and Foo (2013), we regress the CARs from the announcement window (–1, +1) and (0, +1) on several firm and repurchase characteristics known to proxy for repurchase motives. Table A.1 in Appendix A illustrates the descriptive statistics on firm and repurchase characteristics for the 154 sample firms used in the cross-sectional regressions.

In Table 6.3, we present the results from the regressions of the CARs on repurchase and firm characteristics. A pooled OLS regression is employed to estimate our results. To test whether this is in fact correct, we first employ the Hausman specification tests to decide between fixed or random effects. Since we cannot reject the null at a significant level, the random-effect model is preferable to a fixed-effect model. Second, we employ the Breusch–Pagan Lagrange multiplier test to choose between the random-effect model and simple pooled OLS regression. Here we also fail to reject the null and conclude that pooled OLS regression is the preferred model. Moreover, to test for multicollinearity, we employ the variance inflation factor (VIF) test. As none of the explanatory variables exceed the threshold recommended by Wooldridge (2003), our regression does not suffer from multicollinearity. See Appendix B for test results.

Table 6.3 Cross-sectional regressions on CARs
The table reports regressions of CARs from the announcement windows (–1, +1) and (0, +1) on repurchase and firm characteristics. See Table A.2 in Appendix A for variable definitions. The sample consists of 819 share repurchase transactions for the period January 2005 to December 2014. The standard errors of the coefficients have been adjusted for heteroskedasticity using White's (1980) procedure. *p*-values are in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

	CAR (–1, +1)	CAR (0, +1)
Ln(Size)	–0.001**	–0.001*
	(0.047)	(0.068)
Pre-CAR (–10,–2)	–0.059**	–0.002*
	(0.023)	(0.094)
Repurchase Size	–0.495	–0.318
	(0.105)	(0.151)
Return on assets	–0.006	0.008
	(0.823)	(0.756)
Market-to-book	–0.000	–0.000
	(0.164)	(0.121)
Intangibles-to-assets	–0.020*	–0.020**
	(0.053)	(0.027)
Cash	0.030	0.019
	(0.112)	(0.248)
Leverage	–0.001	–0.006
	(0.952)	(0.496)
Intercept	0.014*	0.014*
	(0.075)	(0.058)
Adjusted R^2	0.025	0.021
VIF	1.18	1.20
Number of observations	819	819

Testing for the price impact of firm characteristics related to the signaling undervaluation hypothesis, we obtain mixed results. We find evidence that abnormal returns in the announcement window can be related to firm size, intangibles-to-assets and pre-event CAR. However, we do not find that the market-to-book ratio and the repurchase size have a significant effect on abnormal returns.

From Table 6.3 we observe that the relationship between pre-event CAR and event CAR is significantly negative. This result indicates that the worse the stock price performance prior to the repurchase transaction, the more positive is the market reaction. Firms that experience declining stock prices in the period preceding repurchases transactions are more likely to signal

undervaluation through repurchases (Ikenberry et al., 2000). Our result is consistent with the results of Akyol and Foo (2013), Chan et al. (2004) and Zhang (2005). As expected, we observe that on average, the market seems to react more positively to repurchase transactions conducted by small firms. Our result on firm size is consistent with the findings of Ikenberry et al. (1995) and Grullon and Michaely (2002), who find that due to higher information asymmetry, small firms can use share repurchases as an effective tool to signal to the market that their stock is undervalued. Contrary to our expectation, we observe that event CAR decreases with the size of intangible assets. This variable is meant to capture the degree of asymmetric information between insiders and outsiders regarding the value of the firm's assets (Marosi & Massoud, 2007). Our result is not consistent with the results of Barth and Kasznik (1999), who find that firms with more intangible assets experience positive repurchase-announcement returns.

Initially, we expected that the bigger the repurchase size, the stronger the signaling effect. In contrast to our expectations, repurchase size is not significant, indicating that the size of the repurchase does not explain any variation in event CAR. The result is consistent with the finding of Zhang (2005), who reports that event CAR is not affected by the size of the repurchase transaction. Similar to the findings of Andriosopoulos and Lasfer (2013) and Ikenberry et al. (1995), we do not find that the market-to-book ratio is significantly related to abnormal returns around the announcement window.

Focusing on firm characteristics related to the agency cost of free cash flow, we do not find significance on any of the variables. A plausible explanation may be that firms with high cash balance are already anticipated by the market to engage in repurchase activity. Our result is consistent with the findings of Chan et al. (2004).

Consistent with Andriosopoulos and Lasfer (2013), leverage does not have an impact on abnormal returns, suggesting that share repurchases in Norway are not likely to be undertaken to achieve optimal leverage or gain from the tax shield benefits. The absence of relationship could be due to the fact that repurchases in Norway, were until recently, not allowed to be financed with

debt. As a result the potential effect a share repurchase can have on the firm's capital structure is limited.

Overall, we find some evidence in favor of the signaling undervaluation hypothesis; however, the evidence is not persistent across all proxy variables. Our results indicate that the price impact of repurchase transactions is negatively related to the size of the firm, the preceding drift in stock price, and the intangibles-to-assets ratio. Nevertheless, we do not find evidence that the price impact in the announcement window is related to the agency cost of free cash flow hypothesis or to the optimal capital structure hypothesis.

To asses for robustness, we follow Fenn and Liang (2001) and winsorize all of the variables in the sample below the 1st percentile and above the 99th percentile to see if our results are affected by extreme outliers. The results are presented in Table B.4 in Appendix B and remain qualitatively the same.

6.3 Long-term performance of repurchasing firms

In the previous sections, we found evidence that repurchase transactions typically follow after a negative drift in the stock price. In addition, the more negative the pre-event drift in stock price, the more positive is the market reaction. Our results are seemingly indicative of the signaling undervaluation hypothesis, and may suggest that managers time their repurchases. Obernberger (2014) argues that managerial timing is based on the manager's ability to generate long-term abnormal returns to non-tendering shareholders. This is consistent with Ikenberry and Vermaelen (1996), who argue that long-term value of share repurchases relies on managers' ability to exploit undervaluation errors.

If managers possess informational advantage over the market when timing repurchases, we should expect wealth redistribution from tendering to non-tendering shareholders (Barclay & Smith, 1988). However, if repurchases are triggered by other motives, such as to provide price support, then we should not expect this wealth redistribution. As many former studies show, long-term performance analysis presents a classical test for assessing the market-

timing ability of repurchasing managers.[13] If managers' time repurchases based on their private information then according to the semi-strong version of market efficiency, stock prices will gradually adjust over time to the extent that this private information becomes public. In other words, repurchasing firms would experience abnormal returns as a consequence of positive information surprises at a later stage. In this section, we employ both BHAR, and calendar-time portfolio approaches discussed in Section 5.2 to measure long-term performance of repurchasing firms. Long-term returns are analyzed across holding periods of 1, 2, and 3 years. This naturally leads to differing event firm sample across the three respective periods, although only marginally.

Buy-and-hold abnormal returns

Table 6.4 presents long-term abnormal returns using the BHAR measure with monthly returns. Abnormal returns are calculated relative to industry-matched control portfolios. The industry-matched control portfolios are formed based on the industry classification GICS. Each sample firm in the portfolio is allocated to a benchmark portfolio based on the same two-digit GICS code. In an attempt to improve the robustness of our analysis, we initially excluded certain repurchasing firms that are likely to have significant impact over their respective benchmark due to their large size. This led to the exclusion of Statoil (Oil and Gas), Telenor (Telecommunication), Yara (Basic Materials), and DNB (Financials). However, our results, not shown here, remain qualitatively the same.

[13] Dann (1981), Ikenberry et al. (1995), Peyer and Vermaelen (2009), among others.

Table 6.4 Annual and compounded BHARs
This table reports monthly BHARs following share repurchases for up to three years. The benchmark portfolios are industry-matched control portfolios based on the same two-digit GICS code. Significance level is determined via bootstrapping. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A		Annual buy-and-hold returns			
	N	Repurchase firms	Benchmark Portfolio	Diff.	*p*-value
Year 1	146	11.91%	9.70%	2.20%	0.4038
Year 2	143	8.26%	13.34%	–5.07%	0.1768
Year 3	137	2.03%	–0.85%	2.88%	0.4618
Panel B		Compounded buy-and-hold returns			
	N	Repurchase firms	Benchmark Portfolio	Diff.	*p*-value
Year 1	146	11.91%	9.70%	2.20%	0.4038
Year 2	143	20.10%	22.49%	–2.40%	0.7161
Year 3	137	15.05%	12.96%	2.09%	0.7500

As highlighted in Section 5.2, the BHAR approach is prone to cross-sectional dependence. To account for this bias, we implement the bootstrapping procedure suggested by Lyon, Barber, and Tsai (1999).[14] We assert that this adjustment enhances the robustness of BHAR and helps build further confidence in our findings.

We report the annual as well as the compounded buy-and-hold returns for both the repurchasing firms and the benchmark portfolio. While the first-year annual and compounded buy-and-hold returns are the same, the compounded returns are naturally higher in the second and third year due to the effect of annual compounding. As illustrated in Table 6.4, repurchasing firms demonstrate superior compounded returns over one- and three-year holding periods and inferior performance over a two-year holding period relative to the benchmark. However, after matching the repurchasing firms' BHARs with the benchmark index, we do not observe any significant difference in performance of repurchasing firms. For example, the compounded BHARs for the repurchasing firms over a three-year holding period are

[14] The bootstrapping procedure draws 1000 bootstrapped resamples from the original sample of abnormal returns and calculates the skewness-adjusted t-statistic using each resample to address the cross-correlation and skewness bias

15.05% in comparison to 12.96% for the benchmark index; however, the difference (2.09%) is statistically insignificant as indicated by the corresponding high p-value. These results imply that repurchasing firms' long-term performance does not systematically vary from the benchmark portfolio, hence indicating no evidence in favor of abnormal performance.

Calendar-time portfolio approach

The results based on calendar-time approach are reported under Table 6.5. We estimate the long-term performance of repurchasing firms relative to the Fama and French (1993) three-factor model and the Carhart (1997) four-factor model to compute Jensen's alpha, which in this case measures abnormal performance. As highlighted in Section 5.2, the calendar-time approach may suffer from heteroskedasticity. To mitigate this issue, we follow Ikenberry, Lakonishok, and Vermaelen (2000), and employ weighted least square (WLS) in addition to standard OLS to estimate abnormal performance.

Table 6.5 reports that calendar time portfolio return series is positively related to SMB and the market, and negatively related to HML and MOM risk factors. Our results across both OLS and WLS are qualitatively similar with the reported alphas being insignificant for all holding periods. Overall, our calendar-time portfolio results provide no evidence in favor of abnormal performance.

Table 6.5 Calendar-time portfolio regressions
The table presents regressions using the calendar-time portfolio approach. The portfolios are rebalanced each month and an equal-weighted excess return is calculated. Alpha measures the average monthly abnormal return on portfolios of repurchasing firms. *p*-values are in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

Panel A: Carhart four-factor model

	Holding period	Alpha	Market	SMB	HML	MOM	Adj. R^2	Obs.
OLS	1-year	0.0139%	0.7527	0.1687	–0.0718	–0.0220	0.7680	2491
		(0.2281)	(0.0000)	(0.0000)	(0.0000)	(0.1388)		
	2-year	0.0136%	0.7445	0.1591	–0.0658	–0.0188	0.7840	2491
		(0.2175)	(0.0000)	(0.0000)	(0.0000)	(0.1989)		
	3-year	0.0109%	0.7456	0.1657	–0.0564	–0.0053	0.7986	2491
		(0.2966)	(0.0000)	(0.0000)	(0.0000)	(0.7079)		
WLS	1-year	0.0099%	0.7450	0.1664	–0.0625	–0.0427	0.7675	2491
		(0.6909)	(0.0000)	(0.0000)	(0.0000)	(0.0044)		
	2-year	0.0101%	0.7309	0.1499	–0.0462	–0.0480	0.7827	2491
		(0.6955)	(0.0000)	(0.0000)	(0.0006)	(0.0013)		
	3-year	0.0105%	0.7393	0.1559	–0.0360	–0.0334	0.7975	2491
		(0.6917)	(0.0000)	(0.0000)	(0.0075)	(0.0185)		

Panel B: Fama–French three-factor model

	Holding period	Alpha	Market	SMB	HML	Adj. R^2	Obs.
OLS	1-year	0.0130%	0.7501	0.1638	–0.0715	0.7677	2491
		(0.2574)	(0.0000)	(0.0000)	(0.0000)		
	2-year	0.0128%	0.7422	0.1549	–0.0656	0.7837	2491
		(0.2439)	(0.0000)	(0.0000)	(0.0000)		
	3-year	0.0107%	0.7450	0.1645	–0.0564	0.7986	2491
		(0.3058)	(0.0000)	(0.0000)	(0.0000)		
WLS	1-year	0.0089%	0.7397	0.1547	–0.0605	0.7674	2491
		(0.7751)	(0.0000)	(0.0000)	(0.0000)		
	2-year	0.0091%	0.7264	0.1372	–0.0444	0.7831	2491
		(0.7773)	(0.0000)	(0.0000)	(0.0009)		
	3-year	0.0103%	0.7371	0.1477	–0.0351	0.7981	2491
		(0.7425)	(0.0000)	(0.0000)	(0.0087)		

Conclusion on long-term performance

Overall, both BHAR and calendar-time portfolio results indicate that repurchasing firms do not experience significant abnormal returns in the long run. In other words, we fail to find evidence that managers possess superior timing ability. In the event where repurchases were on average driven by informational advantage, we would have expected significant positive abnormal returns over the long run. Even if we choose to disregard the high *p*-

values, our results carry too low of an economic significance to support managerial timing ability.

An alternative explanation of our results may be that markets in fact do not underreact to information conveyed through repurchase transactions, which are generally perceived to be far more credible as opposed to mere share repurchase programs that are not binding commitments. In the absence of under-reaction, stock prices adjust immediately to reflect the fundamental value of the firm. Consequently, the firm should not experience abnormal returns. However, this logic assumes that the extent of undervaluation is effectively capped to just the event-day reaction, which in our case equates to approximately 0.5%. As Ikenberry et al. (1995) argue, it is implausible that managers would be able to detect such small valuation errors and then subsequently act upon them. In other words, 0.5% is not any greater than the daily standard deviation of returns for most stocks. Managers plausibly have valuation concerns of greater magnitude when they choose to conduct share repurchase with the motive of correcting mispricing.

The observed tendency of firms to engage in repurchases after a significant negative drift in the stock price may initially give the impression of market timing. However, the failure to yield subsequent abnormal returns goes against the principles of the market timing hypothesis. An alternative explanation put forward by Ginglinger and Hamon (2007) is that repurchases are largely driven by price support motives where managers engage in contrarian trading preceding a significant negative drift in the stock price.

In conclusion, we are not able to reject the null hypothesis that managers do not time the market. Our findings are in accordance with Zhang (2005), who finds no evidence for repurchasing firms' ability to generate long-term abnormal outperformance using a matching BHAR approach on his complete sample of repurchasing firms. In another related study, Obernberger (2014) arrives at similar findings and concludes that the empirical evidence is not in line with the notion of the market timing hypothesis. However, our results are inconsistent with the findings of Chan et al. (2007) and Dittmar and Field (2015), who find evidence of managerial timing ability.

7 Conclusion and Further Research

The purpose of this paper was to contribute to the limited knowledge of actual share repurchase activity. Using unique data on daily open market repurchases conducted in Norway for the period 2005–2014, we find that repurchase transactions are on average preceded by a negative drift in the stock price. The average abnormal returns in the announcement window are 0.54%. Using a cross-sectional regression we find that small firms and pre-event negative drift in the stock price can explain the abnormal returns in the announcement window. These results lend some credence to the signaling undervaluation hypothesis stating that managers pursue repurchases when they perceive their stock to be undervalued. However, we do not find evidence that repurchasing firms exhibit superior abnormal performance over the long run. This result suggests that managers on average do not time the market based on informational advantage. Taken together, these results have an important implication for the conclusions reached in prior studies investigating the long-term abnormal performance of repurchasing firms.

Finally, we suggest two topics that could further enrich the understanding of share repurchases. First, it would be interesting to analyze how insider ownership affects repurchase activity. Fried (2005b) argues that the credibility of repurchase as a potential signal of undervaluation may improve with increased insider ownership. Therefore, managers with high ownership stake have greater incentives to time the market. Second, we think it may be of interest to analyze how the manager's timing ability is affected by the firm's institutional ownership base. Arguably institutional investors are informed agents, and would therefore make it difficult for managers to time the market. Unfortunately, our limited data sources have constrained our ability to incorporate these interesting features, and thus they remain open questions to future researchers.

8 Appendix

A Descriptive statistics for cross-sectional regressions

Table A.1 Descriptive statistics on variables used in the regression models

Variables	Average	SD	Minimum	Maximum
CAR(–1, +1)	0.0040	0.0450	–0.3722	0.1893
CAR(0, +1)	0.0037	0.0342	–0.1283	0.1732
Ln(Size)	8.8103	2.3568	3.6501	13.1973
Pre-CAR (–10, –2)	–0.0079	0.0715	–0.3555	0.3753
Repurchase Size	0.0027	0.0087	0.0000	0.1000
Return on assets	0.0685	0.0899	–0.5211	0.4518
Market-to-book	2.6619	2.6046	0.0600	24.9800
Intangibles	0.1552	0.1566	0.0000	0.6309
Cash	0.1169	0.1019	–0.1179	0.4866
Leverage	0.2203	0.1835	0	0.6988

Table A.2 Definition of variables

Variables	Definition
Size	Natural log of the market capitalization
Pre-CAR (–10, –2)	CARs –10 to –2 days prior to the event
Repurchase Size	Number of share repurchased divided by total shares outstanding
Return on assets	Net income divided by total assets
Market-to-book	Market value of equity divided by book value of equity
Intangibles	Total intangibles scaled by total assets
Cash	EBITDA less capital expenditures scaled by total assets
Leverage	Total debt scaled by total assets

B Robustness check for cross-sectional regressions

Table B.1 Hausman test for random or fixed effects
u_i correlated with regressors, random effect model is appropriate.

	Coefficients			
Variable	Fixed	Random	Difference	S.E.
Ln(Size)	–0.0095	–0.0013	–0.0082	0.0033
Pre-CAR (–10,–2)	–0.0015	0.0040	–0.0055	0.0070
Repurchase Size	–0.0125	–0.1480	0.1355	0.1084
Return on assets	0.0227	0.0160	0.0067	0.0006
Market-to-book	0.0011	0.0002	0.0009	0.0075
Intangibles-to-assets	0.0040	–0.0202	0.0242	0.0187
Cash	0.0148	0.0615	–0.0467	0.0105
Leverage	–0.0240	–0.0050	–0.0190	0.0168

H_0: difference in coefficients not systematic
Chi2(8) = (b–B)'[(V_b–V_B)^(–1)](b–B) = 12
Prob > Chi2 = 0.1493

Table B.2 Breusch–Pagan Lagrange multiplier test
No variance across firms detected. OLS is the appropriate model.

	Variance	SD
CAR	0.0012	0.0341
e	0.0010	0.0314
u	0.0017	0.0255

H0: Var(u) = 0 across panel entities
Chibar2(01) = 0.11
Prob > Chibar2 = 0.3727

Table B.3 Variance inflation factors
Multicollinearity is not a problem.

Variables	VIF
Ln(Size)	1.08
Pre-CAR (–10,–2)	1.03
Repurchase Size	1.07
Return on assets	1.48
Market-to-book	1.03
Intangibles-to-assets	1.07
Cash	1.55
Leverage	1.30

To test if the results in Table 6.3 in Section 6.2 are affected by extreme outliers, we winsorize all variables in the sample below the 1st percentile and above the 99th percentile. Table B.1 illustrates the results from this analysis.

Table B.4 Cross-sectional regression on CARs (winsorized).
The table reports regressions of CARs from the (–1, +1) and (0, +1) event window on repurchase and firm characteristics winsorized at the 1st percentile and above the 99th percentile. The sample consists of 819 share repurchase trades for the period January 2005 to December 2014. The standard errors of the coefficients have been adjusted for heteroskedasticity using White's (1980) procedure. *p*-values are in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

	CAR (–1, +1)	CAR (0, +1)
Ln(Size)	–0.001*	–0.001*
	(0.083)	(0.089)
Pre-CAR (–10,–2)	–0.060**	–0.002*
	(0.033)	(0.091)
Repurchase Size	–0.632	–0.396
	(0.115)	(0.169)
Return on assets	–0.005	0.012
	(0.875)	(0.632)
Market-to-book	–0.000	–0.000
	(0.932)	(0.992)
Intangibles-to-assets	–0.020*	–0.020**
	(0.055)	(0.027)
Cash	0.033	0.022
	(0.136)	(0.214)
Leverage	0.000	–0.005
	(0.997)	(0.590)
Intercept	0.015*	0.012*
	(0.095)	(0.060)
Adjusted R^2	0.025	0.023
VIF	1.23	1.25
Number of observations	819	819

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